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APPLICATION NUMBER: 60/519,531
FILING DATE: November 12, 2003
RELATED PCT APPLICATION NUMBER: PCT/US04/37574

Certified by



Jon W Dudas

Acting Under Secretary of Commerce
for Intellectual Property
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16179 U.S. PTO

Practitioner's Docket No. 100325.0237PRO

PATENT

Preliminary Classification
Proposed Class:
Subclass:

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60/519531



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: John Mak and Richard B. Nielsen

For: Solvent Filtration System

Mail Stop Provisional Patent Application
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

COVER SHEET FOR FILING PROVISIONAL APPLICATION
(37 C.F.R. § 1.51(c)(1))

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 C.F.R. § 1.51(c)(1)(i). The following comprises the information required by 37 C.F.R. § 1.51(c)(1):

1. The following comprises the information required by 37 C.F.R. § 1.51(c)(1):
2. The names of the inventors are (37 C.F.R. § 1.51(c)(1)(ii)):

1. John Mak
2242 Salt Air Drive
Santa Ana, CA 92705
USA

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I hereby certify that this paper, along with any document referred to, is being deposited with the United States Postal Service on this date November 12, 2003 in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 as "Express Mail Post Office to Addressee" Mailing Label No. EL961800565US.

Date:

11/12/03

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2. Richard B. Nielsen
18 Callender Court
Laguna Niguel, CA 92677
USA

3. The title of the invention is (37 C.F.R. § 1.51(c)(1)(iv)):

Solvent Filtration System

4. The name, registration, customer and telephone numbers of the practitioner are (37 C.F.R. § 1.51(c)(1)(v)):

Name of practitioner: Robert D. Fish
Reg. No. 33880
Tel. 714-641-5100
Customer No. 34284

5. The docket number used to identify this application is (37 C.F.R. § 1.51(c)(1)(vi)):

Docket No. 100325.0237PRO

6. The correspondence address for this application is (37 C.F.R. § 1.51(c)(1)(vii)):

Rutan & Tucker, LLP
611 Anton Blvd., Suite 1400
Costa Mesa, CA 92626
USA

7. Statement as to whether invention was made by an agency of the U.S. Government or under contract with an agency of the U.S. Government. (37 C.F.R. § 1.51(c)(1)(viii)).

This invention was NOT made by an agency of the United States Government, or under contract with an agency of the United States Government.

8. Identification of documents accompanying this cover sheet:

A. Documents required by 37 C.F.R. § 1.51(c)(2)-(3):

Specification:	No. of pages	4
Drawings:	No. of sheets	1

B. Additional documents:

9. Fee

The filing fee for this provisional application, as set in 37 C.F.R. § 1.16(k), is \$160.00 for other than a small entity.

10. Fee payment

Fee payment in the amount of \$160.00 is being made at this time.

11. Method of fee payment

Charge Account No. 502191, in the amount of \$160.00.

A duplicate of this Cover Sheet is attached.

Please charge Account No. 502191 for any fee deficiency.

Date: 11/12/2003



David Zoetewey
Registration No. 45258
Rutan & Tucker, LLP
611 Anton Blvd., Suite 1400
Costa Mesa, CA 92626
USA
714-641-5100
Customer No. 34284

SOLVENT FILTRATION SYSTEM

Field of Invention

Solvent filtration design and control in gas treating processes including various amine processes and physical solvent processes, in particular large solvent treating units, such as dimethyl ether poly-glycols units that are heavily contaminated with solids and particulates.

Background

The solvents in amine or physical solvent units must be filtered and their quality and purity monitored to ensure the gas treatment performance. Slip-stream filtration typical 10% to 20% of the circulating solvent are used to keep solvent clean. Unless solids such as metal sulfide, iron carbonate, iron oxide, mill scales, and other corrosion products are removed from solvent, they will foul columns and vessels, heat exchangers, and carbon bed filters. They will also erode the protective iron sulfide films from internal piping surfaces, accelerating pipe erosion. Calcium and magnesium carbonates or sulfates are generally introduced when raw water is used as makeup that are also problematic when sufficiently accumulated in the system. These contaminants, solids and particulates must be removed from the circulating solvent for satisfactory operation. However, since these contaminants are saturated with hazardous components such as H₂S, COS, and carbonyl, the filter changeout operation would require special handling equipment and procedure; and improper handling of these materials will endanger operation personnel.

With respect to the solvent being treated in the filtration of the invention, it should be recognized that numerous amine solvents and physical solvents and mixtures thereof are appropriate. There are numerous amine solvents that are applicable including the common used amines such as MEA, DGA, DIPA and MDEA. There are numerous physical solvents known in the art, and exemplary solvents include propylene carbonate, tributyl phosphate, normal methyl pyrrolidone, and other various polyethylene glycol dialkyl ethers. Alternatively, suitable solvents may also include an enhanced tertiary amine or other solvent having similar behavior as a physical solvent. However, it is generally preferred that the solvent comprises a mixture of dimethyl ethers of polyethylene glycols and water.

Typically, many processors are using filters with disposable media such as cartridges or throwaway bags to remove these solids. With disposable media, the media purchase costs and labor for changeouts will add up over time. In addition, changing out cartridges is a time-consuming process, and requires special handling due to the presence of hazardous gases in the filtered materials. The used filter cartridges also create a disposal problem, and not environmental desirable.

Other filter methods commonly used include the precoat filter that uses diatomaceous earth with small particle sizes in the range of 10 microns diameter. While this type of filter medium has more capacity and is less costly than the cartridge type filters and allows longer duration of operation between changeout, the removal and disposal of the contaminated filters is hazardous and environmental undesirable.

For these reasons, many processors are now switching to cleanable-media filters. While the clean-in-place filters can remove solids and particulates from the solvent, and can be automated to some extent to avoid hazards and costs associated with manual replacement of filter elements, the backwashing cleaning step in these systems also indiscriminately remove the valuable solvents. The loss of solvent during the

backwashing operation may be acceptable for small plants, but it becomes very costly and economically prohibitive for larger plants, especially when the solvent is highly valued.

The invention pertains to an automatic system that uses two filtration type systems – a first etched type (sintered metal or equivalent type) filter that can withstand high differential pressure followed by a second cartridge type filter. The first filter is designed to remove the majority of the solids, typically from 5000 ppm down to 20 ppm, and the second filter is designed to remove the residual of the solids from 20 ppm down to 5 ppm with particulate size of 1 microns or less. The etched type is preferred as they contain precision stacked discs that can withstand high-pressure differential required during the cleaning step and they are typically assembled without welding or brazing of the element media. Alternatively the sintered metal type filters can be used.

The invention includes a first step that recovers the solvent trapped inside the etched type (or sintered metal) filter with the use of a water rinse system. A second step removes the undesirable solids with pressurized nitrogen. The recovered diluted solvent is sent to a recovery tank, where the diluted solvent is further cleaned with a separator device prior to recycle and reused in the process. The sludge or filtered cake, containing the solvent depleted undesirable solids and particulates, is removed from the etched filter. The filter system is designed with automatic cleaning logic, controlled by changes in differential pressure across the etched filter. As solids build up on the media, this differential pressure increases and when it reaches a preset level, the filter system automatically initiates cleaning. As a result, the system is always adjusting to process dynamics, avoiding major process problems, and losses of valuable solvent.

The operation of the filtration system is fully automatic and occurs under an inert and safe nitrogen environment. All displacement vapors during the blowback process are recycled back to the process resulting in no emission to the environment. For removal of the ultra fine particles, an electrostatic type precipitator may be installed upstream of the first filter to promote conglomeration of the fine particles.

The invention provides great benefits to the environments and plant operations by recognizing the need to improve plant safety, limit emissions of hazardous waste, eliminate disposal of filter elements, and more significantly reduce the solvent losses while providing safety in design to the filter changeout operation.

Process Description

Refer to Figure 1. Contaminated solvent 1 with solid contents typically 2000 ppm to 5000 ppm is fed from a slip-stream from the solvent circulation stream typically at 5% to 10% of total solvent circulation, which is a reduction from a conventional system that typically requires 10% to 20% slip stream filtration.

During the filtration operation, stream 1 passes through valve 66, to the etched filter 52. For removal of ultra fine particles (such as less than 1 micron size), an electrostatic type precipitator 57 is installed upstream to promote conglomeration of the fine particles. The solids and particulates content in the contaminated solvent is removed by filter 52 typically from 5000 ppm to 20 ppm, and exits the filter via valve 62, forming stream 6. The clean solvent is passed to a second filter 53 that further removes the solids and particulates content down to the 5 ppm level with particulate size no greater than 1 micron diameter. The fine filtration step, a polishing step of the solvent, ensures that the solvent is maintained at the highest quality, not realized in conventional filtration system design in refinery or chemical plants.

The filter cleaning operation is initiated by a high-pressure differential across the etched filter indicated by pressure differential switch set at typically 25 psi to 50 psi. During this operation, the filter outlet valve 62 is closed and the filter bypass valve 65 is opened, thus diverting the solvent through line 5 to the second filter 53, via line 6. The solvent is continued filtered using the second filter during the first filter cleaning operation.

For recovery of the solvent trapped in the first filter, water stream 3 is introduced via valve 69, through line 2, flowing through filter 52, and then out to tank 55 via line 9 and valve 61 and line 11. Filter 53 contains filter elements or cartridge 68 for the final polishing step.

This washing step removes over 99% of solvent trapped in the etched filter prior to the N2 blowdown step. The diluted solvent is further separated in tank 55 using an electrostatic precipitator or equivalent separator 67 that separates the fines (less than 5 to 10 microns diameter) from the diluted solvent. The separator produces a waste stream 14 that can be safely disposed, and a cleaned solvent 13 that is returned to the process, further ensuring the quality of the recycle solvent.

When the washing step is completed as indicated by the low-pressure differential in instrument 80 across the first filter, valve 64 and valve 61 are closed. Next, valve 60 is opened introducing nitrogen through line 9 to the etched filter. Nitrogen is supplied at typically 50 to 100 psig pressure using the surge drum 51. The high-pressure nitrogen would dislodge the filtrate from the etched filter which is removed via line 10, valve 64 to the waste tank 54. The solid sludge is removed as stream 13 from the system. The solid sludge contains minimum amount of solvent that can now be safely removed from the system. The operation is based on a timer sequence that can be adjusted to provide the best cleaning results.

During the blowdown step, the displacement vapors are recycled back through line 16 via valve 71 to the low pressure nitrogen surge drum 72, thereby all the emissions are eliminated with this design. Makeup nitrogen 19 is supplied to surge drum 72 maintaining the necessary pressure and nitrogen inventory.

After the filter is cleaned, the nitrogen valve 60 is closed, the first filter inlet valve 66 is opened and the bypass valve 65 is opened. The solvent is rerouted to the etched filter 52 and then the second filter 53, the filtration cycles are repeated. During the filtration period, low-pressure nitrogen supplying from offsite facility is compressed by compressor 50 to the surge drum 51, until the pressure switch in the surge tank reaches 70 to 100 psig. With a high pressure is achieved, the compressor operation can be stopped, and the nitrogen surge tank is then ready for the next cleaning cycle.

Optionally, a second etched filter may be in parallel with the etched filter 52 such that when the etched filter 52 is being cleaned, the second etched filter facilitates continued operation of a process system and visa versa.

The advantages of this invention are :

- Maintain quality of solvent
- Recover expensive solvent
- Reduce waste and environmental impacts

Eliminate hazards during filter changeout
Automated system minimizing operator attention

It solves the problems of:

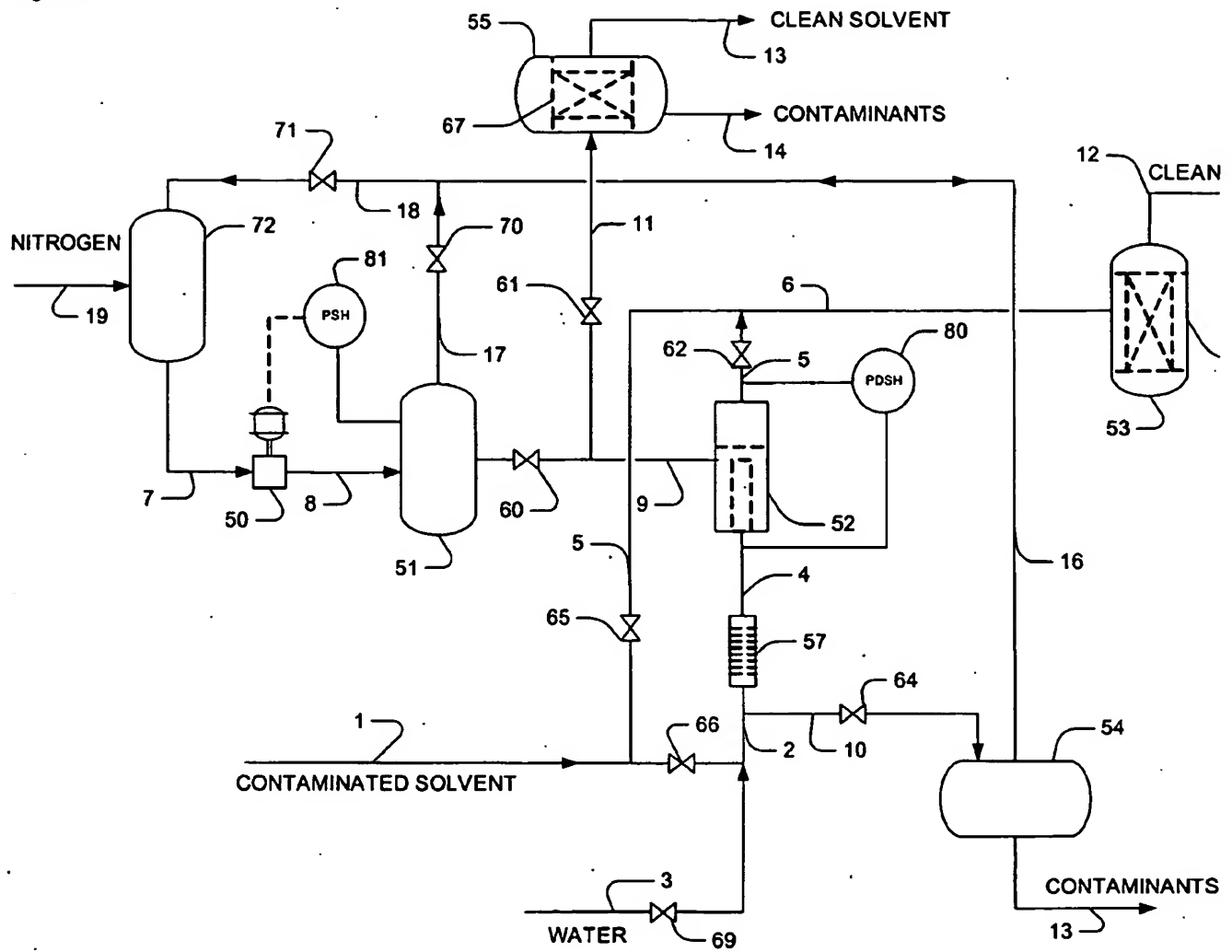
- Solvent contaminants buildup in gas treating processes.
- Solvent losses during filter changeout
- Hazards and costs for filter changeout

The novelty of this invention are:

- Dual filtration systems – etched filter followed by cartridge filters. Etched filters are common in aerospace industry but not commonly used in solvent filtration in refinery or chemical plants.
- Separator is used in the solvent recovered tank to further separate the fines from the solvent prior to returning to the process.
- Use of a water rinse system for recovery of 99% recovery of solvent
- N2 blow system that remove solids to a waste tank for safe disposal
- Automatic switching processing, requiring no operator attention

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